

**TOWARD A NEW FEDERAL POLICY FOR TECHNOLOGY:
The Outline Emerges**

John M. Logsdon

August 1972

**CASE FILE
COPY**

Staff Discussion Paper 408

PROGRAM OF POLICY STUDIES IN SCIENCE AND TECHNOLOGY

**The George Washington University
Washington, D.C.**

This working document is reproduced for private circulation only.

It is intended to be used as a means for promoting an informal exchange of ideas within the staff of the Program of Policy Studies in Science & Technology. It does not necessarily represent the final opinions of the author.

Discussion Papers are subject only to an informal review prior to reproduction. Hence, no opinions, statements of fact, or conclusions contained in this document should be attributed to the Program or its contracting agencies.

TOWARD A NEW FEDERAL POLICY FOR TECHNOLOGY:
The Outline Emerges

by

John M. Logsdon
The George Washington University

August 1972

Staff Discussion Paper 408

The research on which this paper is based was partially supported by NSF Grant GS-34902. The paper is a revision of an article which appears in *Technology Review*, October/November 1972.

PROGRAM OF POLICY STUDIES IN SCIENCE AND TECHNOLOGY
The George Washington University
Washington, D. C.
established under NASA Research Grant NGL 09-010-030

ABOUT THE AUTHOR

John M. Logsdon is currently Director of the Graduate Program in Science, Technology, and Public Policy at George Washington University, Washington, D.C., where he is Assistant Professor of Public Affairs and Political Science. Dr. Logsdon is also a staff member of the university's Program of Policy Studies in Science and Technology. He is currently directing a research project on "Changing National Priorities and Public Policy for Science and Technology." Dr. Logsdon studied physics (B.S.) at Xavier University and political science (Ph. D.) at New York University; he is the author of The Decision to Go to the Moon: Project Apollo and the National Interest (M.I.T. Press, 1970).

Several years ago, a review of the science and technology policies of the United States concluded that the "technological enterprise" was "indissolubly linked to the goals of American society, which is trying to build its future on the progress of science and technology."¹ During the past several years, emphasis within the United States government has shifted away from objectives such as increasing international power and prestige and toward objectives such as improving the quality of domestic life and assuring the continued health of the nation's economy. This shift in priorities has resulted in the need to adapt, among others, public policies for the support, use, and control of science and technology. Such a revision has been underway in Washington for the past several years. Federal policy for science and technology underwent particularly intense examination during late 1971, and the results of that examination are reflected in the first-ever Presidential message to Congress on science and technology, delivered on March 16, 1972.* One long-time student of science and public policy suggests that the proposals put forth by President Nixon in his March message "deserve searching debate, for, if they are adopted, the current period will be remembered as the time of the most significant turning point in national science

¹Organization for Economic Cooperation and Development, Reviews of National Science Policy: the United States (Paris: 1968), p. 347

* The text of the message is included as an appendix, pp. 21-30

policy since the late 1940's."² This article, by tracing the origins, substance, and implications of the President's proposals, will hopefully provide one basis for such debate.

There are two themes underlying the elevation of technology policy to a matter of Presidential concern. One is the belief that federal research and development efforts should be made more relevant to the domestic problems facing the nation and that the civilian agencies of the government should thus have a substantially larger share of the federal R & D budget. The notion of applying our technological capabilities, especially those resulting from federal investments in space and defense programs, to domestic undertakings is not new. Such "conversion" has been discussed ever since the decline in aerospace spending and in military R & D in the mid 1960's produced by the end of the decade a surplus of highly trained manpower. This led policy-makers to look for new ways to use the skills of these scientists and engineers. A shift in overall national priorities towards emphasis on domestic issues has provided a political context for the conversion issue, but until last year this question had not generated sufficient pressure to force the government into seriously considering a significant program of civil technological applications.

One aspect of the conversion issue which does have strong political overtones is the currently-depressed job market for scientists and

²Dael Wolfe in Science, July 7, 1972, p. 13

engineers; the desire to create employment opportunities related to new civilian R & D projects prior to this year's election was an influential consideration in initiating last year's White House review¹ of technology programs.

Another politically potent theme behind last year's review of R & D policy was the unsatisfactory condition of the nation's economy and the search for both short and long-term remedies for economic problems. In studying the economic crisis, top government officials became convinced that there was a definite, but not clearly understood, link between investment in research and development and increases in productivity, success in international economic competition, and new employment opportunities. They also became convinced that the nation as a whole was underinvesting in industrial R & D and that it was necessary for the government to devise and implement incentives to increase such investment to a level that would return the economy to a healthy state and keep it there.

In July 1971 the White House Domestic Council began an effort to identify "new technological opportunities" (NTO) that were both related to a national need and at the same time would contribute to stimulating the economy. This review was perhaps the most intensive examination of the substance of and rationale for federal involvement in supporting non-defense research and development ever undertaken. Significant changes analyzed or suggested during the course of the study included: the initiation of large-scale demonstration projects involving several federal agencies; the revision of federal structure for scientific and technological policy-making; across-the-board tax

credits to stimulate private investment in research and development, or some other form of government action to achieve the same purpose; revisions in federal anti-trust and patent laws; and other substantial revisions in current technology policy.

The White House initiated the review of technological opportunities with the overly optimistic hope that such an analysis could "find the means to insure that . . . the remarkable technology that took . . . Americans to the moon can also be applied to reaching our goals here on earth."³ Those in charge of the NTO study hoped to identify a few "domestic Apollo programs" (at least in the sense of being dramatic) which the President could announce in order to emphasize his intention to pursue a new federal policy for technology. Instead, the review demonstrated that the context for stimulating technological innovation in the private sector is much different from that existing in the defense or space sectors, and that the economic, political, legal, and insitutional constraints related to civilian applications of technology pose significant and largely unanalyzed obstacles to the President's often-repeated aim of "harnessing the wonders of science to the service of man." President Nixon has said as much; in his 1972 State of the Union address, he noted that "much more needs to be known about stimulating and applying research and development."

The attempts by the NTO review to find new areas for federal R & D spending were thus in a sense unsuccessful, but certainly not from a lack of effort. During the course of the study, each of the

³ President Richard M. Nixon, Message to Congress, Sept. 9, 1971

15 federal agencies involved in civilian R & D was asked to suggest technological undertakings related to domestic opportunities or foreign trade. The responses were analyzed by a series of Executive Office task forces organized according to issue area--transportation, natural resources, law enforcement, etc. Shortly after the review began last summer, William Magruder, former head of the SST program, was appointed as a special consultant to the President and named as director of the NTO exercise. Magruder broadened the search for new projects by asking a large number of private sector firms and trade associations to submit their ideas on technological initiatives and the means to finance them. After internal review, each NTO task force met with a blue-ribbon advisory panel to receive comments on the alternative projects under consideration. Finally, Magruder borrowed individuals from NASA and NSF with aerospace program management experience to help him put together a final report which contained organization, schedule, and cost information and program plans for each project proposal. During the whole NTO effort, staff members from the Office of Science and Technology, the Council of Economic Advisors, and the Office of Management and Budget worked closely with the NTO staff.

Possible technological initiatives seriously considered during the review would have involved the addition of \$1.49 billion to this year's budget and five-year costs of approximately \$11 billion; in a sense, however, these numbers have little meaning, since no one anticipated approval of all projects examined. Among the major projects proposed

were the development of new nuclear power systems for commercial ships, of offshore ports for deep-draft tankers, of advanced social communications systems, and of emergency medical care techniques, the full development of high-speed ground transportation in the Northeast Corridor, and a campaign against kidney diseases.

As White House advisers John Erlichman, Peter Flanigan, George Shultz and Peter Peterson, together with science adviser Edward David and budget official Donald Rice, reviewed Magruder's proposals during December, it became clear that there were complex questions of technological ripeness, environmental impact, institutional capability, economic soundness and political feasibility related to each, and that there had not been enough time during the NTO exercise to perform satisfactory analysis of these questions. Lacking such analyses, Magruder and others involved in the review were unable to convince the top decision makers that the beneficial results of any major innovation were both large enough and certain enough to justify the budgetary costs and political risks involved. This led the White House to abandon what Presidential science adviser Edward David calls the "sledgehammer" approach to revising its science and technology policies.⁴ Apparently the President and his advisers have become convinced that they should adopt more moderate and incremental tactics in achieving the fundamental revisions they have in mind. Though deciding not to move ahead as rapidly as many had anticipated, the White

⁴ Interview with author, May 24, 1972

House apparently was convinced by the results of the NTO review both of the real contributions that increased investment in R & D could make to achieving national objectives and of the need to undertake further studies of the best ways of assuring that such investments are made wisely.

NEW POLICY OUTLINED

Even though specific policy innovations and major new programs have not yet appeared, there is little doubt that there is a major change in federal policy for science and technology being proposed, the key element of which is a more intimate relationship between public and private R & D efforts in non-defense fields. The basic concepts of this new policy have been articulated by the President in his March 16 message to Congress on science and technology and in several other recent White House pronouncements.

The President has called for "an overall strategic approach in the allocation of federal scientific and technical resources." By "strategic" here the President means a closer link between national goals and priorities and federal R & D investment. Key elements of this approach are a determination "to better apply our scientific resources in meeting civilian needs" and to do so through "a new partnership in science and technology--one which brings together the Federal Government, private enterprise, state and local governments, and our universities and research centers in a coordinated, cooperative effort to serve the national interest."

These policy proposals are in several ways departures from the relationship of the federal government to the national scientific and technological enterprise of the past twenty-five years. Since World War II, the bulk of federal spending for R & D has always gone into the defense, space, atomic energy, and health research fields. Hollomon notes that, during the same period, the United States invested in "a smaller fraction of publicly supported research and development for economic purposes . . . than any other industrial nation."⁵ Now the federal government is proposing to take the lead in stimulating the process of technological innovation for a wide range of industrial activities in which the private sector has traditionally had that lead role--such areas as non-nuclear energy production, ground transportation and housing. In addition, there is the intention to accelerate the growth in the R & D budgets of those agencies of the federal government that deal with domestic issues. In the current fiscal year, the R & D budget for civilian agencies is still only 25 per cent of total federal R & D spending, although the civilian section of the R & D budget has increased by 65 per cent in the past three years.

Washington also hopes to stimulate state and local governments to utilize the technological resources existing in federal laboratories, in universities, and in high-technology industrial firms. Yet, in fiscal 1968, state and local governments spent only one penny on

⁵ J. Herbert Hollomon, "Technology in the United States: Issues for the 1970's," Technology Review, June 1972, p. 14. This article and another in the July/August issue of Technology Review discuss many of the topics covered by this paper from a somewhat different viewpoint.

R & D for each dollar similarly spent by the federal government. There has been a recent increase in activity aimed at developing at the State and local levels both the desire and the capability to relate science and technology to their concerns. Partnership with the federal government in such an undertaking is the theme of a Federal Council for Science and Technology report Public Technology: A Tool for Solving National Problems and a Council of State Government study Power to the States: Mobilizing Public Technology. Federal, State and local officials and industrial representatives met in June for a "National Action Conference on Intergovernmental Science and Technology Policy," which proposed mechanisms for implementing the partnership concept. The staffs of the Office of Science and Technology and the Office of Intergovernmental Relations in the Executive Office of the President are now evaluating these and other suggestions.

Potentially the most important and controversial aspect of the new technology policy is the call for federal involvement in stimulating research and development related to goods and services produced by private industry, and sold for profit in the market. The belief that government involvement is required stems from a conviction that the United States as a nation is underinvesting in research and development, particularly in terms of R & D aimed at increased productivity and economic growth. Economists who support such involvement, including the Council of Economic Advisers, argue that market mechanisms, if left to operate by themselves, will continue to result in such underinvestment. This is so, the CEA argued in this year's Economic Report, because "although an investment in R & D may produce benefits exceeding its costs

from the viewpoint of society as a whole, a firm considering the investment may not be able to translate enough of these benefits into profits on its own products to justify the investment."⁶ The conclusion that has been drawn from this line of reasoning is, as the President indicated last March, that "it is appropriate for the federal government to encourage private research and development to the extent that the market mechanism is not effective in bringing needed innovations into use."

In his August 15, 1971 message announcing economic controls, President Nixon directed the Treasury Department to develop "new tax proposals for stimulating research and development" for presentation to Congress this year; after such proposals were studied as part of the NTO effort, the White House decided not to adopt them or any other across-the-board technique for R & D stimulus. According to science adviser David, supporters of such proposals as a 7 per cent tax credit for R & D investment were not able to show that they "would, in fact, accomplish the desired end. . . . Their proposals were made without adequate evidence of cost-effectiveness, economic tradeoffs, and the reallocation of private and public resources."⁷ In addition to tax policy, other methods of stimulating private investment in R & D examined during the NTO study included aspects of patent, procurement,

⁶ Economic Report of the President, (Washington: 1972), p. 126

⁷ Quoted in Claude Barfield, "White House Views Intense Technology Hunt as Useful Exercise," National Journal, May 6, 1972, p. 763. This article and another in the May 13 National Journal are more detailed accounts of the NTO study and its results.

regulatory, and anti-trust policies. The administration has made some policy modifications intended to encourage the operation of small high-technology firms and has indicated that it will interpret antitrust laws to allow industries to undertake joint R & D efforts if those efforts improve the allocation of the nation's resources. But more basic changes in the economic policies that provide the context for industrial R & D will likely await the results of further analyses of the implications of such changes.

Federal intervention in private sector research and development, either through direct subsidies or through more indirect forms of stimulation, is not without its critics. Eads and Nelson argue that a "conscious national decision to achieve very high rates of technical progress in a particular field is tantamount to a decision that traditional decentralized modes of R & D organization, decision-making, and risk-taking be superseded by a much more concentrated and centralized structure." The result of such centralization, they suggest, is likely to be costly and highly inefficient R & D programs. Eads and Nelson also believe that "government commitments to particular technologies and products pose an unusually difficult problem of public control."⁸

If implemented, this new technology policy will represent a very significant departure from what has gone before. But, as noted above,

⁸ George Eads and Richard R. Nelson, "Government Support of Advanced Civilian Technology," Public Policy, Summer, 1971, pp. 405-427.

last year's NTO study demonstrated that the government does not now know either how to go about stimulating technological innovation in the private sector or how to match the R & D programs and capabilities of federal agencies to national needs and opportunities in enough detail to move ahead rapidly. The Economic Report of the President notes that "while it is clear that Federal involvement is essential to prevent underinvestment in R & D, the optimal amount of this activity is much less clear. The proper allocation of R & D among alternative activities presents a further problem."⁹ Other issues still to be resolved include the choice of appropriate mechanisms for federal stimulation of the private R & D process and possible reorganization of the management structure for federal research and development activities. If there are to be fundamental changes in federal policy for science and technology, important questions of what to do, who should do it, who should pay for it, and how it should be managed must still be answered.

NEW PROGRAMS TO STUDY TECHNOLOGY POLICY

In an attempt to develop answers to some of these questions, two new programs were included in this year's budget. One, called the "Experimental R & D Incentives Program," will be conducted jointly by the National Science Foundation and by the National Bureau of Standards.

⁹ Economic Report, pp. 127-128

The other is called the "National R & D Assessment Program;" it will also be managed by NSF.

In his science and technology message, the President indicated that the purpose of the incentives program would be "to determine effective ways of stimulating non-Federal investment in research and development" by a series of experiments "to test a variety of partnership arrangements among the various levels of government, private firms and universities." The need for such experiments derives directly from the lack of information on the consequence of various forms of R & D incentives which was uncovered by the NTO study. The President suggested that the experimental incentives program would test new arrangements for cost sharing, patent licensing, and research support, among others. The NBS portion of the experimental technology incentives program will be focused on relationships among universities and one or more of the following: federal, state and local governments, research institutes, government laboratories, and to some degree, private industry. Both programs will attempt to create controlled circumstances in which prototype operations can provide some of the experience needed to evaluate the effectiveness of one or a combination of incentives for stimulating the innovation process, and for assuring that the results of that process are effectively utilized.

The program of national R & D assessment will aim at providing a fuller understanding of how science and technology contribute to national goals and objectives. The hope is that the program will provide a capability for in-depth policy analysis of the processes of R & D investment and technological innovation. Areas the assessment program

intends to investigate include: overall R & D patterns; the incentive structures and decision points that have produced existing means for the support, performance, and utilization of R & D, both in the United States and in other countries; and the implications of various policy options for future R & D activity.

When confronted with the need to evaluate alternate means of stimulating technological innovation and applying its results, the White House last year found that its technical and economic advisers were unable to say with any confidence what the results of a particular policy choice were likely to be. It may take several years to learn whether these two modestly funded but broadly conceived programs of research and experimentation will be able to generate enough credible information in future considerations related to technology policy.

INSTITUTIONAL ARRANGEMENTS EXAMINED

Because there were no large new federal programs approved as a result of the NTO review, the White House has not yet has to answer a question which arose early in the study and persisted throughout--how would such new civilian R & D programs be managed? One finding was that there was an almost total lack of systems management and program definition capabilities outside of the defense, space, and atomic energy agencies. In order to make it possible, in the face of such a lack, to undertake large-scale technological efforts in the civil sector, the concept of joint ventures between a cabinet-level civilian agency and one of the high-technology agencies--NASA, NBS, or AEC--was examined.

at the time of the NTO review. Under such an arrangement, a civilian department might have the policy leadership and overall administrative responsibilities for a particular project, while a technology agency would be responsible for technical management and procurement activities. This year's budget contained proposals for several joint Department of Transportation--NASA efforts on air and ground transportation which reflects this joint venture approach. If these efforts overcome the bureaucratic obstacles to success and if the government does decide in the near future to go ahead with any major new R & D program in the civil sector, the joint venture model is the likely choice for organizing that program.

The very existence of the NTO review emphasized the prior lack of any systematic means for the White House on a continuing basis to relate existing agency R & D programs and emerging technological potentials to national goals. This was especially so in terms of analyzing the full context of economic, political, legal, and other issues related to domestic R & D undertakings. The eventual development of a new institutional capability in the Executive Office of the President to make such overall assessments and to translate them into coherent federal R & D programs involving several agencies seems very likely, although the precise nature of the organization to perform this technology policy overview function is still unclear. This ability to relate specific projects to national goals and priorities is a key element in the Administration's "strategic" approach to R & D decisions. Presidential science adviser Edward David talks of the need for an "activist" philosophy and "more managerial viewpoint" with respect to

R & D within the Executive Office and the corresponding need to plan, coordinate, and evaluate ongoing and proposed federal R & D activities at that level.¹⁰ The old notion of a Department of Science and Technology to perform many of these functions does not match the tendency of the Nixon administration to centralize policy-making activities within the institutional White House, and thus it is most likely either that the existing Office of Science and Technology will be reorganized and assigned this policy overview function or that a new White House entity, perhaps along the model of the Council of Economic Advisers, will be created to undertake it.

OTHER PROPOSALS

This article has concentrated on the technology policy proposals which have been put forth by the Nixon administration because they have been spelled out in some detail, because they are responses to issues which were being discussed even before Nixon took office, and because they are in some ways similar to the less detailed proposals of Democratic presidential candidate George McGovern. (Given the overall context of McGovern's campaign proposals, these apparent similarities may mask very basic differences in underlying philosophy and specific emphases.) The issue of conversion from defense-oriented to civilian-oriented federal R & D has been of particular interest to McGovern for almost ten years, and he has proposed several pieces of legislation

¹⁰ David Interview

related to it. McGovern's proposals for R & D policy include:

1. "greatly expanded funding for research and development across the whole range of public concerns";
2. "effective methods of stimulating research in the private sector . . .," including "research with purely commercial application";
3. a "search for ways to stimulate and encourage smaller technical enterprise."¹¹

One area in which McGovern's proposals do differ greatly from those of the Nixon administration is the Democratic nominee's pledge of an immediate \$10 billion economic stimulus which would include technology-intensive contracts for new and rehabilitated housing, public transportation systems, and environmental protection.

In mid-August the Senate approved a set of major initiatives related both to the conversion process and to the use of science and technology for domestic purposes. These initiatives are contained in a bill, S. 32, which was developed by Senator Edward Kennedy, who has become the leading Democratic spokesman on science and technology issues; Senator McGovern is a strong supporter of Kennedy's proposals. This bill was originally called the "Conversion Research, Education and Assistance Act of 1971," but now has been considerably broadened in scope and renamed the "National Science Policy and Priorities Act of 1972." The bill authorizes over \$800 million, to be spent over three years, for the development and testing of new "civil science" systems to provide improved public services such as health care, public safety, housing, and other such domestic needs. It also provides \$200 million

¹¹ Congressional Record, April 20, 1972, pp. S6499-6500

to aid the conversion process to a R & D system dominated by civilian programs. The Kennedy bill would establish a Civil Science Systems Administration within the National Science Foundation to manage most of the new R & D programs it authorizes; such an organization would represent an even more fundamental shift in the nature of NSF as an agency supporting basic research than does the current Research Applied to National Needs (RANN) program.

S. 32 also puts Congress on record as declaring as matters of national policy that:

1. federal funding for R & D must increase at a rate which will assure "an annual qualitative growth in the gross national product needed to sustain a full employment economy";
2. scientists and engineers must have continuing employment opportunities;
3. federal funds for civilian R & D must be increased so that they at least achieve parity with military R & D;
4. federal programs for civilian R & D must be focused on meeting national needs in priority areas.¹²

Although the Senate approved S. 32 by a 70-8 vote, it is unlikely that the House will complete action on the proposal during the current session. This will leave matters in the hands of the new Congress that will convene next January; the bill would have to be reintroduced and pass through both Houses again.

¹² Congressional Record, August 17, 1972, p. S 13917

CONCLUSION

Although partisan political considerations have had some influence on the reshaping of national policy for science and technology, the basic factors underlying such changes are related to shifts during the past half-decade or so in the economic, social, and political concerns of the nation. There has been a growing consensus that the links between science, technology, and such goals as national power and economic progress, the strategy to cement that link, and the institutions to implement that strategy are all in the need of overhaul. Robert Gilpin caught the essence of this feeling in noting the need for the United States to develop a "more explicit technological strategy designed to increase the social return of its immense investment in science and technology and to minimize its negative returns."¹³ Hollomon's recent articles are a comprehensive review of the considerations leading to such a conclusion.

In recent years, top decision-makers have come to see science and technology policy neither as isolated from the mainstream of national issues nor as a means of solving all the nation's problems. Rather, research and development investments are now being viewed as one among the many basic elements to be considered in formulating public policies. This beginning of the integration of technology policy with domestic policy is perhaps the most significant result of the

¹³ Robert Gilpin, "Technological Strategies and National Purpose," Science, July 31, 1970, p. 446

activities in Washington during the past year.

To date, there have been many declarations of intent related to changes in technology policy, but little in the way of funds for specific new projects or in the way of actual policy modifications with concrete impacts. The speed with which such developments occur will provide one test of the government's intent to implement its new technology policy, one which appears to match the mood and needs of the nation.

APPENDIX

*The President's Message to the Congress. March 16, 1972**To the Congress of the United States:*

The ability of the American people to harness the discoveries of science in the service of man has always been an important element in our national progress. As I noted in my most recent message on the State of the Union, Americans have long been known all over the world for their technological ingenuity—for being able to “build a better mousetrap”—and this capacity has undergirded both our domestic prosperity and our international strength.

We owe a great deal to the researchers and engineers, the managers and entrepreneurs who have made this record possible. Again and again they have met what seemed like impossible challenges. Again and again they have achieved success. They have found a way of preventing polio, placed men on the moon, and sent television pictures across the oceans. They have contributed much to our standard of living and our military strength.

But the accomplishments of the past are not something we can rest on. They are something we must build on. I am therefore calling today for a strong new effort to marshal science and technology in the work of strengthening our economy and improving the quality of our life. And I am outlining ways in which the Federal Government can work as a more effective partner in this great task.

The importance of technological innovation has become dramatically evident in the past few years. For one thing, we have come to recognize that such innovation is essential to improving our economic productivity—to producing more and better goods and services at lower costs. And improved productivity, in turn, is essential if we are to achieve a full and durable prosperity—without inflation and without war. By fostering greater productivity, technological innovation can help us to expand our markets at home and abroad, strengthening old industries, creating new ones, and generally providing more jobs for the millions who will soon be entering the labor market.

This work is particularly important at a time when other countries are rapidly moving upward on the scientific and technological ladder, challenging us both in intellectual and in economic terms. Our international position in fields such as electronics, aircraft, steel, automobiles and shipbuilding is not as strong as it once was. A better performance is essential to both the health of our domestic economy and our leadership position abroad.

At the same time, the impact of new technology can do much to enrich the quality of our lives. The forces which threaten that quality will be growing at a dramatic pace in the years ahead. One of the great questions of our time is whether our capacity to deal with these forces will grow at a similar rate. The answer to that question lies in our scientific and technological progress.

As we face the new challenges of the 1970's, we can draw upon a great reservoir of scientific and technological information and skill—the result of the enormous investments which both the Federal Government and private enterprise made in research and development in recent years. In addition, this Nation's historic commitment to scientific

excellence, its determination to take the lead in exploring the unknown, have given us a great tradition, a rich legacy on which to draw. Now it is for us to extend that tradition by applying that legacy in new situations.

In pursuing this goal, it is important to remember several things. In the first place, we must always be aware that the mere act of scientific discovery alone is not enough. Even the most important breakthrough will have little impact on our lives unless it is put to use—and putting an idea to use is a far more complex process than has often been appreciated. To accomplish this transformation, we must combine the genius of invention with the skills of entrepreneurship, management, marketing and finance.

Secondly, we must see that the environment for technological innovation is a favorable one. In some cases, excessive regulation, inadequate incentives and other barriers to innovation have worked to discourage and even to impede the entrepreneurial spirit. We need to do a better job of determining the extent to which such conditions exist, their underlying causes, and the best ways of dealing with them.

Thirdly, we must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use. In some cases, laws or regulations may inhibit its implementation. In other cases, the costs of the process may not be worth the benefits it produces. The introduction of some new technologies may produce undesirable side effects. Patterns of living and human behavior must also be taken into account. By realistically appreciating the limits of technological innovation, we will be in a better position fully to marshal its amazing strengths.

A fourth consideration concerns the need for scientific and technological manpower. Creative, inventive, dedicated scientists and engineers will surely be in demand in the years ahead; young people who believe they would find satisfaction in such careers should not hesitate to undertake them. I am convinced they will find ample opportunity to serve their communities and their country in important and exciting ways.

The fifth basic point I would make concerning our overall approach to science and technology in the 1970's concerns the importance of maintaining that spirit of curiosity and adventure which has always driven us to explore the unknown. This means that we must continue to give an important place to basic research and to exploratory experiments which provide the new ideas on which our edifice of technological accomplishment rests. Basic research in both the public and private sectors today is essential to our continuing progress tomorrow. All departments and agencies of the Federal Government will continue to support basic research which can help provide a broader range of future development options.

Finally, we must appreciate that the progress we seek requires a new partnership in science and technology—one which brings together the Federal Government, private enterprise, State and local governments, and our universities and research centers in a coordinated, cooperative effort to serve the national interest. Each member of that partnership must play the role it can play best; each must respect and reinforce the unique capacities of the other members. Only if this happens, only if our new partnership thrives, can we be sure that our scientific and technological resources will be used as effectively as possible in meeting our priority national needs.

With a new sense of purpose and a new sense of partnership, we can make the 1970's a great new era for American science and technology. Let us look now at some of the specific elements in this process.

STRENGTHENING THE FEDERAL ROLE

The role of the Federal Government in shaping American science and technology is pivotal. Of all our Nation's expenditures on research and development, 55 percent are presently funded by the Federal Government. Directly or indirectly, the Federal Government supports the employment of nearly half of all research and development personnel in the United States.

A good part of our Federal effort in this field has been directed in the past toward our national security needs. Because a strong national defense is essential to the maintenance of world peace, our research and development in support of national security must always be sufficient to our needs. We must ensure our strategic deterrent capability, continue the modernization of our Armed Forces, and strengthen the overall technological base that underlies future military systems. For these reasons, I have proposed a substantial increase for defense research and development for fiscal year 1973.

In this message, however, I would like to focus on how we can better apply our scientific resources in meeting civilian needs. Since the beginning of this Administration, I have felt that we should be doing more to focus our scientific and technological resources on the problems of the environment, health, energy, transportation and other pressing domestic concerns. If my new budget proposals are accepted, Federal funds for research and development concerning domestic problems will be 65 percent greater in the coming fiscal year than they were in 1969.

But increased funding is not the only prerequisite for progress in this field. We also need to spend our scarce resources more effectively. Accordingly, I have moved to develop an overall strategic approach in the allocation of Federal scientific and technological resources. As a part of this effort, I directed the Domestic Council last year to examine new technology opportunities in relation to domestic problems. In all of our planning, we have been concentrating not only on *how much* we spend but also on *how* we spend it.

My recommendations for strengthening the Federal role in science and technology have been presented to the Congress in my State of the Union message, in my budget for fiscal year 1973, and in individual agency presentations. I urge the Congress to support the various elements of this new Federal strategy.

1) We are reorienting our space program to focus on domestic needs—such as communications, weather forecasting and natural resource exploration. One important way of doing this is by designing and developing a reusable space shuttle, a step which would allow us to seize new opportunities in space with higher reliability at lower costs.

2) We are moving to set and meet certain civilian research and development targets. In my State of the Union Message, my Budget Message and in other communications with the Congress, I have identified a number of areas where new efforts are most likely to produce significant progress and help us meet pressing domestic needs. They include:

—Providing new sources of energy without pollution. My proposed budget for fiscal year 1973 would increase energy-related research and development expenditures by 22 percent.

—Developing fast, safe, pollution-free transportation. I have proposed spending 46 percent more in the coming fiscal year on a variety of transportation projects.

—Working to reduce the loss of life and property from natural disasters. I have asked, for example, that our earthquake research program be doubled and that our hurricane research efforts be increased.

—Improving drug abuse rehabilitation programs and efforts to curb drug trafficking. Our budget requests in this critical area are four times the level of 1971.

—Increasing biomedical research efforts, especially those concerning cancer and heart disease, and generally providing more efficient and effective health care, including better emergency health care systems.

3) We will also draw more directly on the capabilities of our high technology agencies—the Atomic Energy Commission, the National Aeronautics and Space Administration and the National Bureau of Standards in the Department of Commerce—in applying research and development to domestic problems.

4) We are making strong efforts to improve the scientific and technological basis for setting Federal standards and regulations. For example, by learning to measure more precisely the level of air pollution and its effects on our health, we can do a more effective job of setting pollution standards and of enforcing those standards once they are established.

5) I am also providing in my 1973 budget for a 12 percent increase for research and development conducted at universities and colleges. This increase reflects the effort of the past 2 years to encourage educational institutions to undertake research related to important national problems.

6) Finally, I believe that the National Science Foundation should draw on all sectors of the scientific and technological community in working to meet significant domestic challenges. To this end, I am taking action to permit the Foundation to support applied research in industry when the use of industrial capabilities would be advantageous in accomplishing the Foundation's objectives.

SUPPORTING RESEARCH AND DEVELOPMENT IN THE PRIVATE SECTOR

The direction of private scientific and technological activities is determined in large measure by thousands of private decisions—and this should always be the case. But we cannot ignore the fact that Federal policy also has a great impact on what happens in the private sector. This influence is exerted in many ways—including direct Federal support for such research and development.

In general, I believe it is appropriate for the Federal Government to encourage private research and development to the extent that the market mechanism is not effective in bringing needed innovations into use. This can happen in a number of circumstances. For example, the sheer size of some developmental projects is beyond the reach of private firms particularly in industries which are fragmented into many small companies. In other cases, the benefits of projects cannot be captured by private institutions, even though they may be very significant for the

whole of society. In still other cases, the risks of certain projects, while acceptable to society as a whole, are excessive for individual companies.

In all these cases, Federal support of private research and development is necessary and desirable. We must see that such support is made available—through cost-sharing agreements, procurement policies or other arrangements.

One example of the benefits of such a partnership between the Federal Government and private enterprise is the program I presented last June to meet our growing need for clean energy. As I outlined the Federal role in this effort, I also indicated that industry's response to these initiatives would be crucial. That response has been most encouraging to date. For example, the electric utilities have already pledged some \$25 million a year for a period of 10 years for developing a liquid metal fast breeder reactor demonstration plant. These pledges have come through the Edison Electric Institute, the American Public Power Association, and the National Rural Electric Cooperative Association. This effort is one part of a larger effort by the electrical utilities to raise \$150 million annually for research and development to meet the growing demand for clean electric power.

At the same time, the gas companies, through the American Gas Association, have raised \$10 million to accelerate the effort to convert coal into gas. This sum represents industry's first year share in a pilot plant program which will be financed one-third by industry and two-thirds by the Federal Government. When it proves feasible to proceed to the demonstration stage, industrial contributions to this project will be expected to increase.

APPLYING GOVERNMENT-SPONSORED TECHNOLOGIES

An asset unused is an asset wasted. Federal research and development activities generate a great deal of new technology which could be applied in ways which go well beyond the immediate mission of the supporting agency. In such cases, I believe the Government has a responsibility to transfer the results of its research and development activities to wider use in the private sector.

It was to further this objective that we created in 1970 the new National Technical Information Service in the Department of Commerce. In addition, the new incentives programs of the National Science Foundation and the National Bureau of Standards will seek effective means of improving and accelerating the transfer of research and development results from Federal programs to a wider range of potential users.

One important barrier to the private development and commercial application of Government-sponsored technologies is the lack of incentive which results from the fact that such technologies are generally available to all competitors. To help remedy this situation, I approved last August a change in the Government patent policy which liberalized the private use of Government-owned patents. I directed that such patents may be made available to private firms through exclusive licenses where needed to encourage commercial application.

As a further step in this same direction, I am today directing my Science Adviser and the Secretary of Commerce to develop plans for a

new, systematic effort to promote actively the licensing of Government-owned patents and to obtain domestic and foreign patent protection for technology owned by the United States Government in order to promote its transfer into the civilian economy.

IMPROVING THE CLIMATE FOR INNOVATION

There are many ways in which the Federal Government influences the level and the quality of private research and development. Its direct supportive efforts are important, but other policies—such as tax, patent, procurement, regulation and antitrust policies—also can have a significant effect on the climate for innovation.

We know, for instance, that a strong and reliable patent system is important to technological progress and industrial strength. The process of applying technology to achieve our national goals calls for a tremendous investment of money, energy and talent by our private enterprise system. If we expect industry to support this investment, we must make the most effective possible use of the incentives which are provided by our patent system.

The way we apply our antitrust laws can also do much to shape research and development. Uncertain reward and high risks can be significant barriers to progress when a firm is small in relation to the scale of effort required for successful projects. In such cases, formal or informal combinations of firms provide one means for hurdling these barriers, especially in highly fragmented industries. On the other hand, joint efforts among leading firms in highly concentrated industries would normally be considered undesirable. In general, combinations which lead to an improved allocation of the resources of the nation are normally permissible, but actions which lead to excessive market power for any single group are not. Any joint program for research and development must be approached in a way that does not detract from the normal competitive incentives of our free enterprise economy.

I believe we need to be better informed about the full consequences of all such policies for scientific and technological progress. For this reason, I have included in my budget for the coming fiscal year a program whereby the National Science Foundation would support assessments and studies focused specifically on barriers to technological innovation and on the consequences of adopting alternative Federal policies which would reduce or eliminate these barriers. These studies would be undertaken in close consultation with the Executive Office of the President, the Department of Commerce and other concerned departments and agencies, so that the results can be most expeditiously considered as further Government decisions are made.

There are a number of additional steps which can also do much to enhance the climate for innovation.

1) I shall submit legislation to encourage the development of the small, high technology firms which have had such a distinguished pioneering record. Because the combination of high technology and small size makes such firms exceptionally risky from an investment standpoint, my proposal would provide additional means for the Small Business Investment Companies (SBICs) to improve the availability of venture capital to such firms.

a. I propose that the ratio of Government support to SBICs be increased. This increased assistance would be channeled to small business concerns which are principally engaged in the development or exploitation of inventions or of technological improvements and new products.

b. I propose that the current limit on Small Business Administration loans to each SBIC be increased to \$20 million to allow for growth in SBIC funds devoted to technology investments.

c. I propose that federally regulated commercial banks again be permitted to achieve up to 100 percent ownership of an SBIC, rather than the limited 50 percent ownership which is allowed at present.

d. To enhance risk-taking and entrepreneurial ventures, I again urge passage of the small business tax bill, which would provide for extending the eligibility period for the exercise of qualified stock options from 5 to 8 or 10 years, reducing the holding period for non-registered stock from 3 years to 1 year, and extending the tax-loss carry-forward from 5 to 10 years. These provisions would apply to small firms, as defined in the proposed legislation.

2) I have requested in my proposed budget for fiscal year 1973 that new programs be set up by the National Science Foundation and the National Bureau of Standards to determine effective ways of stimulating non-Federal investment in research and development and of improving the application of research and development results. The experiments to be set up under this program are designed to test a variety of partnership arrangements among the various levels of government, private firms and universities. They would include the exploration of new arrangements for cost-sharing, patent licensing, and research support, as well as the testing of incentives for industrial research associations.

3) To provide a focal point within the executive branch for policies concerning industrial research and development, the Department of Commerce will appraise, on a continuing basis, the technological strengths and weaknesses of American industry. It will propose measures to assure a vigorous state of industrial progress. The Department will work with other agencies in identifying barriers to such progress and will draw on the studies and assessments prepared through the National Science Foundation and the National Bureau of Standards.

4) To foster useful innovation, I also plan to establish a new program of research and development prizes. These prizes will be awarded by the President for outstanding achievements by individuals and institutions and will be used especially to encourage needed innovation in key areas of public concern. I believe these prizes will be an important symbol of the Nation's concern for our scientific and technological challenges.

5) An important step which could be of great significance in fostering technological innovations and enhancing our position in world trade is that of changing to the metric system of measurement. The Secretary of Commerce has submitted to the Congress legislation which would allow us to begin to develop a carefully coordinated national plan to bring about this change. The proposed legislation would bring together a broadly representative board of private citizens who would work with all sectors of our society in planning for such a transition. Should such a change be decided on, it would be implemented on a cooperative, voluntary basis.

STRONGER FEDERAL, STATE AND LOCAL PARTNERSHIPS

A consistent theme which runs throughout my program for making government more responsive to public needs is the idea that each level of government should do what it can do best. This same theme characterizes my approach to the challenges of research and development. The Federal Government, for example, can usually do a good job of massing research and development resources. But State and local governments usually have a much better "feel" for the specific public challenges to which those resources can be applied. If we are to use science and technology effectively in meeting these challenges, then State and local governments should have a central role in the application process. That process is a difficult one at best; it will be even more complex and frustrating if the States and localities are not adequately involved.

To help build a greater sense of partnership among the three levels of the Federal system, I am directing my Science Adviser, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various Federal agencies and the representatives of State and local governments. These discussions should lay the basis for developing a better means for collaboration and consultation on scientific and technological questions in the future. They should focus on the following specific subjects:

- 1) Systematic ways for communicating to the appropriate Federal agencies the priority needs of State and local governments, along with information concerning locally-generated solutions to such problems. In this way, such information can be incorporated into the Federal research and development planning process.

- 2) Ways of assuring State and local governments adequate access to the technical resources of major Federal research and development centers, such as those which are concerned with transportation, the environment, and the development of new sources of energy.

- 3) Methods whereby the Federal Government can encourage the aggregation of State and local markets for certain products so that industries can give government purchasers the benefits of innovation and economies of scale.

The discussions which take place between Federal, State and local representatives can also help to guide the experimental programs I have proposed for the National Science Foundation and the National Bureau of Standards. These programs, in turn, can explore the possibilities for creating better ties between State and local governments on the one hand and local industries and universities on the other, thus stimulating the use of research and development in improving the efficiency and effectiveness of public services at the State and local level.

WORLD PARTNERSHIP IN SCIENCE AND TECHNOLOGY

The laws of nature transcend national boundaries. Increasingly, the peoples of the world are irrevocably linked in a complex web of global interdependence—and increasingly the strands of that web are woven by science and technology.

The cause of scientific and technological progress has always been advanced when men have been able to reach across international boundaries in common pursuits. Toward this end, we must now work to facilitate the flow of people and the exchange of ideas, and to recognize that the basic problems faced in each nation are shared by every nation.

I believe this country can benefit substantially from the experience of other countries, even as we help other countries by sharing our information and facilities and specialists with them. To promote this goal, I am directing the Federal agencies, under the leadership of the Department of State, to identify new opportunities for international cooperation in research and development. At the same time, I am inviting other countries to join in research efforts in the United States, including:

- the effort to conquer cancer at the unique research facilities of our National Institutes of Health and at Fort Detrick, Maryland; and

- the effort to understand the adverse health effects of chemicals, drugs and pollutants at the new National Center for Toxicological Research at Pine Bluff, Arkansas.

These two projects concern priority problems which now challenge the whole world's research community. But they are only a part of the larger fabric of cooperative international efforts in which we are now engaged.

Science and technology can also provide important links with countries which have different political systems from ours. For example, we have recently concluded an agreement with the Soviet Union in the field of health, an agreement which provides for joint research on cancer, heart disease and environmental health problems. We are also cooperating with the Soviet Union in the space field; we will continue to exchange lunar samples and we are exploring prospects for closer cooperation in satellite meteorology, in remote sensing of the environment, and in space medicine. Beyond this, joint working groups have verified the technical feasibility of a docking mission between a SALYUT Station and an Apollo spacecraft.

One result of my recent visit to the People's Republic of China was an agreement to facilitate the development of contacts and exchanges in many fields, including science and technology. I expect to see further progress in this area.

The United Nations and a number of its specialized agencies are also involved in a wide range of scientific and technological activities. The importance of these tasks—and the clear need for an international approach to technical problems with global implications—argues for the most effective possible organization and coordination of various international agencies concerned. As a step in this direction, I proposed in a recent message to the Congress the creation of a United Nations Fund for the Environment to foster an international attack on environmental problems. Also, I believe the American scientific community should participate more fully in the science activities of international agencies.

To further these objectives, I am taking steps to initiate a broad review of United States involvement in the scientific and technological programs of international organizations and of steps that might be taken to make United States participation in these activities more effective, with even stronger ties to our domestic programs.

Finally, I would emphasize that United States science and technology can and must play an important role in the progress of developing nations. We are committed to bring the best of our science and technology to bear on the critical problems of development through our reorganized foreign assistance programs.

A NEW SENSE OF PURPOSE AND A NEW SENSE OF PARTNERSHIP

The years ahead will require a new sense of purpose and a new sense of partnership in science and technology. We must define our goals clearly, so that we know where we are going. And then we must develop careful strategies for pursuing those goals, strategies which bring together the Federal Government, the private sector, the universities, and the States and local communities in a cooperative pursuit of progress. Only then can we be confident that our public and private resources for science and technology will be spent as effectively as possible.

In all these efforts, it will be essential that the American people be better equipped to make wise judgments concerning public issues which involve science and technology. As our national life is increasingly permeated by science and technology, it is important that public understanding grow apace.

The investment we make today in science and technology and in the development of our future scientific and technical talent is an investment in tomorrow—an investment which can have a tremendous impact on the basic quality of our lives. We must be sure that we invest wisely and well.

RICHARD NIXON

The White House
March 16, 1972

STANDARD TITLE PAGE FOR TECHNICAL REPORTS		1. Report No. GWPS-SDP 408	2. Govt. Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle TOWARD A NEW FEDERAL POLICY FOR TECHNOLOGY: The Outline Emerges			5. Report Date August 1972	
			6. Performing Organization Code	
7. Author(s) Professor John M. Jogsdon			8. Performing Organization Rept. No.	
9. Performing Organization Name and Address Program of Policy Studies in Science & Technology THE GEORGE WASHINGTON UNIVERSITY 2100 Pennsylvania Avenue, N.W. Washington, D. C. 20006			10. Project/Task/Work Unit No.	
			11. Contract/Grant No. NASA NGL 09-010-030	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration 400 Maryland Avenue, S.W. Washington, D. C. 20546			13. Type of Report & Period Covered	
			14. Sponsoring Agency Code	
15. Supplementary Notes				
16. Abstracts This paper traces the development of a new federal policy for the support and use of technology. It analyzes the premises underlying such a policy and forecasts likely future developments. The first Presidential message on science and technology is included as an appendix.				
17. Key Words and Document Analysis. 17a. Descriptors Government Policies 0504 Planning 0501				
17b. Identifiers/Open-Ended Terms Technology Policy National Goals				
17c. COSATI Field/Group				
18. Distribution Statement Releasable to public without limitation. Initial distribution from Program of Policy Studies; all subsequent copies from NTIS.			19. Security Class (This Report) UNCLASSIFIED	
			20. Security Class (This Page) UNCLASSIFIED	
			21. No. of Pages 31	
			22. Price \$3.00	